

## REPEATABILITY ESTIMATION OF SEMEN PRODUCTION AND QUALITY OF LOCALS MADURA CATTLE BREED (*Bos indicus*)

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### ABSTRACT

The objective of this study was to evaluate the effect of genetic and environmental factor on locals Madura cattle semen production and quality. A total of 2275 semen collections records from 11 bulls from 2012 to 2014 were analyzed to evaluate the genetic potency of semen productions. Genetic evaluation consists of repeatability estimation of semen volume, sperm concentration and sperm individual motility. Data were analyzed by HGLM (REML) with environmental factors of age, seasons, interval of semen collections, and frequency of ejaculations as fixed effect and bulls as random effect using GENSTAT 16<sup>th</sup> edition. Result showed that age and ejaculation frequency affect to all variables; interval of semen collections affected to both semen volume and sperm concentrations; while seasons only affected to sperm concentrations. Repeatability estimation of semen volume, sperm concentration and sperm individual motility were 0.376, 0.445 and 0.567 respectively. It was concluded that the quality of Madura bulls ejaculate less affected by environmental factors.

Key words: Madura cattle, repeatability, semen production

### ABSTRAK

Penelitian ini bertujuan mengevaluasi pengaruh faktor genetik dan lingkungan terhadap produksi dan kualitas semen pejantan sapi madura. Analisis dilakukan terhadap 2275 catatan penampungan semen dari 11 ekor pejantan sepanjang tahun 2012-2014. Evaluasi yang dilakukan berupa pendugaan nilai ripitabilitas volume, konsentrasi, dan gerak individu spermatozoa. Analisis data dilakukan melalui HGLM (REML) dengan faktor lingkungan umur, musim, interval penampungan dan frekuensi ejakulasi sebagai fixed effect dan pejantan sebagai random effect menggunakan Genstat edisi-16. Hasil penelitian menunjukkan umur dan frekuensi ejakulasi berpengaruh terhadap semua peubah, interval penampungan berpengaruh terhadap volume semen dan konsentrasi spermatozoa sedangkan musim hanya berpengaruh terhadap konsentrasi spermatozoa. Nilai ripitabilitas volume semen, konsentrasi dan gerak individu spermatozoa berturut-turut adalah 0,376; 0,445; dan 0,567. Dapat disimpulkan bahwa produksi dan kualitas semen sapi madura hanya sedikit dipengaruhi oleh faktor lingkungan.

Kata kunci: produksi semen, ripitabilitas, sapi madura

### INTRODUCTION

Madura cattle are one of local Indonesian cattle that has important role in social and cultural life for Madura tribe. Unfortunately, since artificial insemination using Limousin breed being allowed in Madura Island in 2001, the interest of local breeder to breed Madura cattle decreased (Widi *et al.*, 2013). Despite having high economic value, limitation of natural breeding system become a hindrance for the spread and affordable distribution of high quality seeds of Madura cattle (Kutsiyah, 2012). The better Production performance and higher economic value of crossbreeds meats as compared to local Madura cattle, was another reason for this shift of interest (Nurgartiningsih, 2010).

East Java Provincial Government with Singosari National Artificial Insemination Centre (BBIB), attempted to return the interest of local breeder to breed Madura cattle and maintain its population in Madura Island by selection of superior and favourable bulls of Madura cattle, to produce frozen semen, and distributed it through an artificial insemination program. Since the agreement with local governmental in 2010, the demand of frozen semen of Madura cattle increased drastically, so the number of Madura bulls should be increased to meet the demands.

Increasing bulls population was not always an effective solution to meet the demands of frozen semen production. Previous study showed that to maintain production of good quality frozen semen, bulls

reproduction characteristic in the environment of frozen semen production needs to be characterized, because the bulls libido and ejaculate characteristic fluctuated in every collection period (Al-Badry, 2013). Important reproduction parameters to determine the quality and quantity of ejaculate in frozen semen product are semen volume, spermatozoa concentration, and individual motility of spermatozoa per ejaculate (Karoui *et al.*, 2011). Genetic factor and some environmental factors such as age, weather, and semen collecting management were known to affect the quality and quantity of ejaculate (Mathevon *et al.*, 1998; Brito *et al.*, 2002; Fuerst-Waltd *et al.*, 2006; Bhakat *et al.*, 2011).

Madura cattle's frozen semen producer need to understand how genetic and environmental factor influence reproduction parameters of bulls and its consistency in every production period, to achieve efficient production of frozen semen. This study estimated the reproduction consistency in every production period using parameters, such as; semen volume, spermatozoa concentration, and individual motility of spermatozoa as an evaluation to manage future frozen semen production of Madura cattle.

### MATERIALS AND METHODS

#### Material

Data in this study was 2,275 records of Madura bulls semen collection from January 2012 until

December 2014 in BBIB Singosari located in Malang, East Java (7° 50'14.6 "S 112° 38'43.7 "E). The data was recorded from 11 bulls aged 3-7 years old. All bulls were caged individually and received the similar daily ration and care management.

### Collection Process and Semen Evaluation

BBIB Singosari collected semen from Madura cattle bulls twice a week, with an interval of four to five days. Each acquired 1-2 ejaculation with an interval of 15 minutes between each ejaculation. We obtained data of semen volume by reading the scale on collector tube inside the artificial vagina. Semen concentration was obtained by examine a mixture of 35  $\mu$ l semen and 3.5 mL NaCl 0.9% of using minitube® Photometer SDM6. Spermatozoa individual motility was evaluated microscopically with 200x magnification of 0.1  $\mu$ l semen inside 0.1  $\mu$ l diluents at 37-38° C which set up using minitube® slide warmer. All the collection and evaluation process were carried out under ISO 17025:2005 management.

### Data Analysis

The estimation of repeatability value was evaluated on semen volume, spermatozoa concentration, and individual motility which were considered as variate response; with bulls as a random effect representing genetic factor, and fixed effect representing environment factor such as: age (5 category : 30-42 months, 43-54 months, 55-68 months, 69-80 months, and 81-92 months), seasons (4 season: January-March, April-June, July-September, and October-December), collection interval (2 intervals, 3 and 4 days), and ejaculation frequency (2 frequency, ejaculation I and II).

The estimation of repeatability was conducted using intraclass correlation and repeatability value was obtained from the equation,  $r = (\sigma^2 \text{ bulls}) / (\sigma^2 \text{ bulls} + \sigma^2 \text{ residual})$ , adopted from Comadran *et al.* (2011). The value of  $\sigma^2$  bull and  $\sigma^2$  residual were obtained from estimation of antilog "bulls  $\lambda$ " and antilog " $\phi$ ", respectively from HGLM-REML (Hierarchical Generalized Linear Model-Restricted Maximum Likelihood) using software Genstat 16<sup>th</sup> edition (Goedhart and Thissen, 2013).

## RESULTS AND DISCUSSION

### Semen Evaluation

The mean, standard deviation, and variability coefficient of semen volume, spermatozoa concentration, and individual motility from 2012-2014 is presented in Table 1. Semen quality of Madura bulls did not differ from study reported on *Bos indicus* (Brito *et al.*, 2002; Ahmad *et al.*, 2011), *Bos taurus* (Fuerst-Watl *et al.*, 2006; Boujenane dan Boussaq, 2013), and crossbred cattle (Shaha *et al.*, 2008).

### Environment Factor

Analysis using HGLM showed that age and ejaculation frequency affected all variable; while collection interval affected semen volume and spermatozoa concentration; and season only affected spermatozoa concentration (Table 2.). This result corresponded with previous study reported on *Bos taurus* (Mathevon *et al.*, 1998; Fuerts-Waltl *et al.*, 2006; Karoui *et al.*, 2011) and *Bos indicus* (Brito *et al.*, 2002; Ahmad *et al.*, 2011). The effect of age on semen volume, spermatozoa concentration, and individual

**Table 1.** Data of semen volume, spermatozoa concentration, and individual motility of spermatozoa on Madura bulls in BBIB Singosari from 2012-2014

Semen Production Parameter	Data Amount (n)	Mean	Standard Deviation (SD)	Variability Coefficient (%)
Semen volume	2,275	4.08 mL	1.66	40.77
Spermatozoa concentration	2,275	1,059 x 10 <sup>6</sup> /mL	421.5	39.8
Individual spermatozoa motility	2,275	61.6 (%)	16.5	26.77

**Table 2.** Effect of permanent environment factor (fixed effect) on semen volume, spermatozoa concentration, and individual spermatozoa motility in Madura bulls using Wald test

No	Environment factor	Probability (P) value		
		Volume (mL)	Concentration (x10 <sup>6</sup> /mL)	Individual motility (%)
1	Age	0.039	<0.001	0.001
2	Season	0.523	<0.001	0.180
3	Collection interval	<0.001	0.04	0.080
4	Ejaculation frequency	<0.001	<0.001	<0.001

<sup>a)</sup> P>0.05 : not significant different; P<0.05 : significant different; P<0.01: very significant different

**Table 3.** Quantitative character of semen,  $\sigma^2$  bulls,  $\sigma^2$  residual and estimation of repeatability value in semen reproduction parameter in Madura cattle Bull

Semen Quantitative Character	$\sigma^2$ bulls	$\sigma^2$ residual	Estimation of Repeatability Value
Semen value	0.9837	1.633	0.375
Spermatozoa concentration	79,779	99,415	0.445
Spermatozoa individual motility	0.0207	0.0153	0.576

motility was due to the testis growth and maturity followed the bulls aged (Brito *et al.*, 2002; Torres-Junior and Henry, 2005; Moura *et al.*, 2011). The difference in semen quality related to season could be explained by the difference temperature in the environment, photoperiod, humidity, availability of feed, and housing condition (Mathevon *et al.*, 1998; Bhakat *et al.*, 2011); meanwhile, collection interval and ejaculation frequency affected semen due to daily production of spermatozoa, spermatozoa viability inside epididymis, and epididymis capacity (Jones, 1999; Jones, 2004).

### Semen Production Repeatability

The estimation of repeatability value of semen volume, concentration, and individual motility of spermatozoa were carried out using fixed effect (age, season, interval of semen collection, and ejaculation frequency per gathering) and random effect (bulls). Estimated repeatability for semen volume, concentration, and individual motility of spermatozoa were 0.375, 0.445, and 0.576, respectively (Table 3).

Semen volume, concentration, and individual motility of spermatozoa of Madura cattle in this study considered as moderate-high category. Based on repeatability value, the value of 37.5%, 44.5%, and 57.6% variability of semen volume, concentration, and individual motility of spermatozoa, respectively, were caused by genetic diversity of bulls in Madura cattle. This result was similar to the study reported on *Bos taurus* in temperate climate (Taylor and Everett, 1985; Mathevon *et al.*, 1998; Boujenane and Boussaq, 2013).

Bulls adaptability to environment was one of individual genetic factor that have an important role in semen production. Haque *et al.* (2001) reported repeatability value of semen production on *Bos taurus* that lived in tropical environment was lower than the one that lived in temperate environment. Better repeatability value was found in crossbred between *Bos taurus* with local cattle that have better adaptability in tropical environment.

Madura cattle is local cattle that have better adaptability in tropical environment, better tolerance in low quality feed, and better reproduction appearance than Ongole crossbred and Bali cattle (Wijono and Setiadi, 2004). Repeatability value on semen volume, spermatozoa concentration, and individual motility of spermatozoa in Madura bulls was categorized as moderate-high in this study, and it could be due to good adaptability in natural environment in tropical environment that was supported by improvement in maintenance management.

### CONCLUSION

This study showed that Madura cattle have moderate-high repeatability value on the following reproduction parameters: semen volume, spermatozoa concentration, and individual motility of spermatozoa. Genetic factor played a greater role than environment factor in variability of semen production between Madura cattle.

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